MATLAB Algorithms for Rapid Detection and Embedding of Palindrome and Emordnilap Electronic Watermarks in Simulated Chemical and Biological Image Data

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Abstract
Electronic watermarks are used everyday to protect copyrighted materials on the web. But watermarks can also be used to inform the viewer of data (such as photographs and images) as to important aspects of the image such as ownership, location and environmental conditions during the image's creation.
This paper examines the use of palindrome images, images in which the data can be flipped in the left-right direction and leave the image untouched. This is similar to words such as RADAR which when flipped left right is still RADAR. An emordnilap image forms a totally different images when flipped. This is similar to words such as STOP which when flipped left right gives the new word POTS. Emordnilap is palindrome spelled backwards. This paper explores the use of MATLAB algorithms in the rapid detection and embedding of palindrome and emordnilap electronic watermarks in simulated chemical and biological Image Data

Introduction
Watermarking Materials
Electronic watermarks are used everyday to protect copyrighted materials on the web. But watermarks can also be used to inform the viewer of data (such as photographs and images) as to important aspects of the image such as ownership, location and environmental conditions during the image's creation.
This paper examines the use of palindrome images, images in which the data can be flipped in the left-right direction and leave the image untouched. This is similar to words such as RADAR which when flipped left right is still RADAR. An emordnilap image forms a totally different images when flipped. This is similar to words such as STOP which when flipped left right gives the new word POTS. Emordnilap is palindrome spelled backwards. This paper explores the use of MATLAB algorithms in the rapid detection and embedding of palindrome and emordnilap electronic watermarks in simulated chemical and biological Image Data

Objective
The standard approach (Ref 2-4) to watermarking involves putting the cover image in the first 4 significant bits of each pixel and the watermarked image in four least significant bits. Most watermarking tools look for this pattern. But a new class of image has come to our attention called "palindrome and emordrnilap". This new type of image may be causing some watermarking detection tools to miss their target.

Data
Photograph of building credit:
Post Office and Custom House, Battery Street, San Francisco
CALL NUMBER: LOT 3544-37, no. 138 [item] [P&P]
Find any corresponding online LOT(group) record
REPRODUCTION NUMBER: LC-USZ62-27229 (b&w film copy neg.)

Method and Results
Matlab code is give in table marked program 1 and program 2. This is the code that extracts the lower and upper bits in each image and recombines them into the palindrome image and the watermark

Step by step details of the process are given on page 3.

Conclusions
1. Palindrome and Emordnilap watermarking is possible in copyrighted and non copyrighted materials
2. Since they are easily detected and removed Palindrome and Emordnilap watermarks are **probably** not the best of ways to watermark the rightful owner's signature showing that this material is his copyrighted work
3 Palindrome and Emordnilap Watermarked images are easily detected and decoded
4. The Matlab code can easily be paralleled on multiple computers. One computer per image.

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See also ADM001736, Proceedings for the Army Science Conference (24th) Held on 29 November - 2 December 2005 in Orlando, Florida. , The original document contains color images.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
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Acknowledgements

General Reference

A very good online web reference on Watermarking
1) Fabien A. P. Petitcolas The information embedding homepage: digital watermarking http:// www.petitcolas .net/ fabien/ steganography/ email: fapp2@cl.cam.ac.uk

References

Watermarking Copyrighted Materials

1) Will Knight, "Massive search reveals no secret code in web images", NewScientist article online @ http: //www. newscientist.com/ news/news.jsp ?id=ns99991340, 25 Sept 01
2) Gray, Rich,"On the Edge: Hidden in Plain Sight Special to SPACE.com , 01 July 2003 online @http: //www. space.com /businesstechnology/ technology/ ontheedge_0307.html
3) Weeks, Kevin D., "Hiding in plain sight" ,online on the web at http:// community. borland. com/ article/ 0,1410,20586,00.html, also see http://www.jjtc.com/ stegdoc/stegdoc.html
4) Katzenbeisser,Stefan; Petitcolas, Fabien A. P. editors,"Information Hiding Techniques for Digital Watermarking", Artech House Books, January 2000.ISBN 1-58053-035-4, Hardcover, approx. 220 pages

Program 2

MATLAB code to display watermarked images

watermark_flip_display.m

```
function y= watermark_flip_display (watermark_image)
%show that images are palindromes and emordnilaps
image(watermark_image/255) %divide image by 255
axis image % set axis of figure
title('orginal image') % title
figure(gcf) % pick current figure window
pause % pause

[I,J,K]=size(watermark_image); % save dimentions of image
watermark_image=dec2bin(watermark_image,8); % change to 8 bit
binary
watermark_image=fliplr(watermark_image); % flip matrix left to right
watermark_image=bin2dec(watermark_image); % change to decimal
watermark_image=reshape(watermark_image,I,J,K); %reshape to
image size
image(watermark_image/255) % display image
axis image % pick axis and image shape
title('flipped image') % title after flipped left right
figure(gcf) % pick the most current figure window
```

Program 1. Matlab Code for watermark_test.m M file

```
a=double(imread('custom_a.jpg')); %load in image one
b=double(imread('custom_b.jpg')); %load in image two

[I,J,K]=size(a); % save dimentions of both images
% both images used as input are the same size

a=dec2bin(a,8); % change a into binary 8 bits
b=dec2bin(b,8); % change b into binary 8 bits

a=a(:,1:4); % keep the 4 high bits MSB most sig bits
b=b(:,1:4); % keep the 4 high bits LSB least sig bits
a_flip=fliplr(a); % flip the matrix left-right
b_flip=fliplr(b); % flip the matrix left-right

a_a=[a,a_flip]; % make a palindrome matrix of just a
b_b=[b,b_flip]; % make a palindrome matrix of just b
a_b=[a,b_flip]; % make a emordnilap matrix a with a
                %watermark of b
a_a=bin2dec(a_a); % change a_a from binary to decimal
b_b=bin2dec(b_b); % change a_a from binary to decimal
a_b=bin2dec(a_b); % change a_b from binary to decimal

a_a=reshape(a_a,I,J,K); % reshape to look like a picture
b_b=reshape(b_b,I,J,K); % reshape to look like a picture
a_b=reshape(a_b,I,J,K); % reshape to look like a picture

watermark_flip_display(a_a) % show orginal & flipped same
pause % pause
watermark_flip_display(b_b) % show orginal & flipped same
pause % pause
watermark_flip_display(a_b) % orginal & flipped different
```

Step by Step description of process for making Palindrome watermark

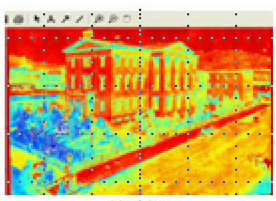
IR Image of House
Data Decimal & Binary

53 = 00110101
78 = 01001110
100 = 01100100
75 = 01001011
47 = 00101111
7 = 00000111
11 = 00001011
52 = 00110100
38 = 00100110
5 = 00000101

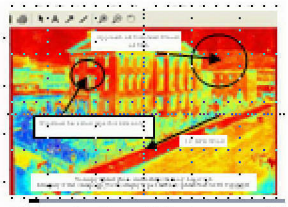
Annotation Watermark
Data Decimal & Binary

23 = 00010111
78 = 01001110
100 = 01100100
17 = 00010001
10 = 00001010
38 = 00100110
11 = 00001011
21 = 00010101
92 = 01011100
68 = 01000100

A Sample of Data from Each Image



Cover image
Custom House



Annotation Watermark

Some Data Points From "House" and From "Watermark Annotation written on Image of House" See enlargements next page

A

0011
0100
0110
0100
0010
0000
0000
0011
0010
0000

B

0101
1110
0100
1011
1111
0111
1011
0100
0110
0101

C

0001
0100
0110
0001
0000
0010
0000
0001
0101
0100

D

0111
1110
0100
0001
1010
0110
1011
0101
1100
0100

STEP 1
Split Each Matrixes in two

Most Sig. And Least Sig. Bits

A_F

1100
0010
0110
0010
0100
0000
0000
1100
0100
0000

C_F

1000
0010
0110
1000
0000
0100
0000
1000
1010
0010

STEP 3
Flip Matrix Left-Right

A and C

FINAL STEP

W

A	A_F
0011	1100
0100	0010
0110	0110
0100	0010
0010	0100
0000	0000
0000	0000
0011	1100
0010	0100
0000	0000

Palindrome Image Gives upper bits from House No Matter How Flipped

X

C	C_F
0001	1000
0100	0010
0110	0110
0001	1000
0000	0000
0010	0100
0000	0000
0001	1000
0101	1010
0100	0010

Palindrome Image Gives upper bits from Watermark No Matter How Flipped

Y

A	C_F
0011	1000
0100	0010
0110	0110
0100	1000
0010	0000
0000	0100
0000	0000
0011	1000
0010	1010
0000	0010

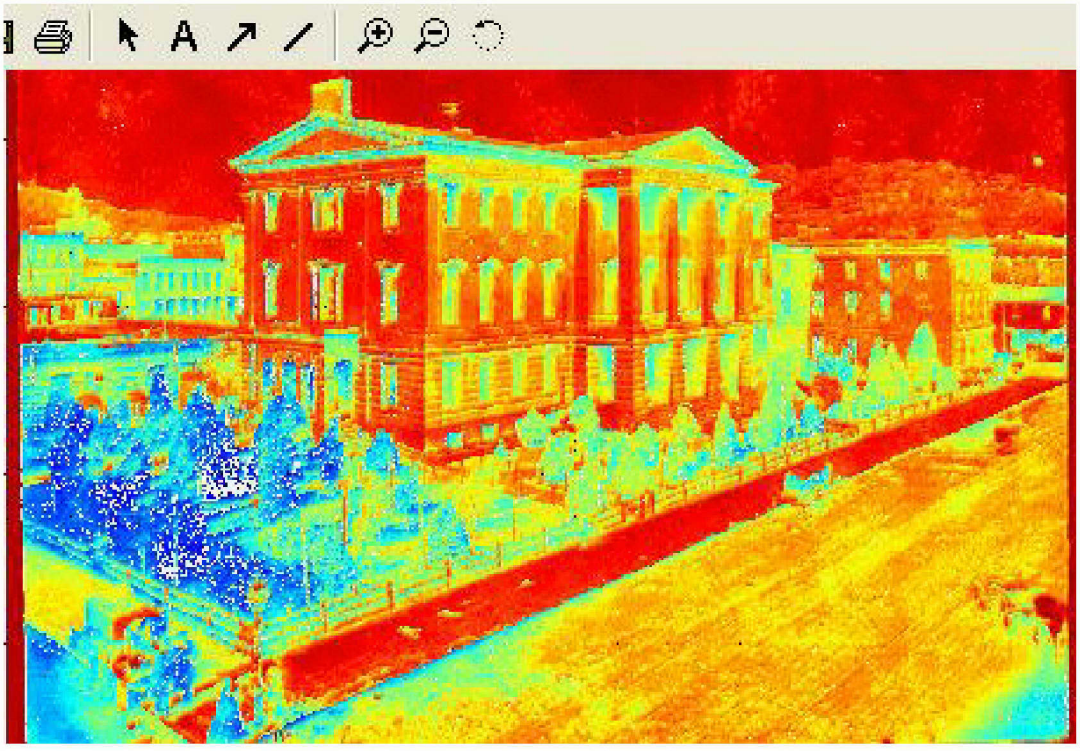
Z

C	A_F
0001	1100
0100	0010
0110	0110
0001	0010
0000	0100
0010	0000
0000	0000
0001	1100
0101	0100
0100	0000

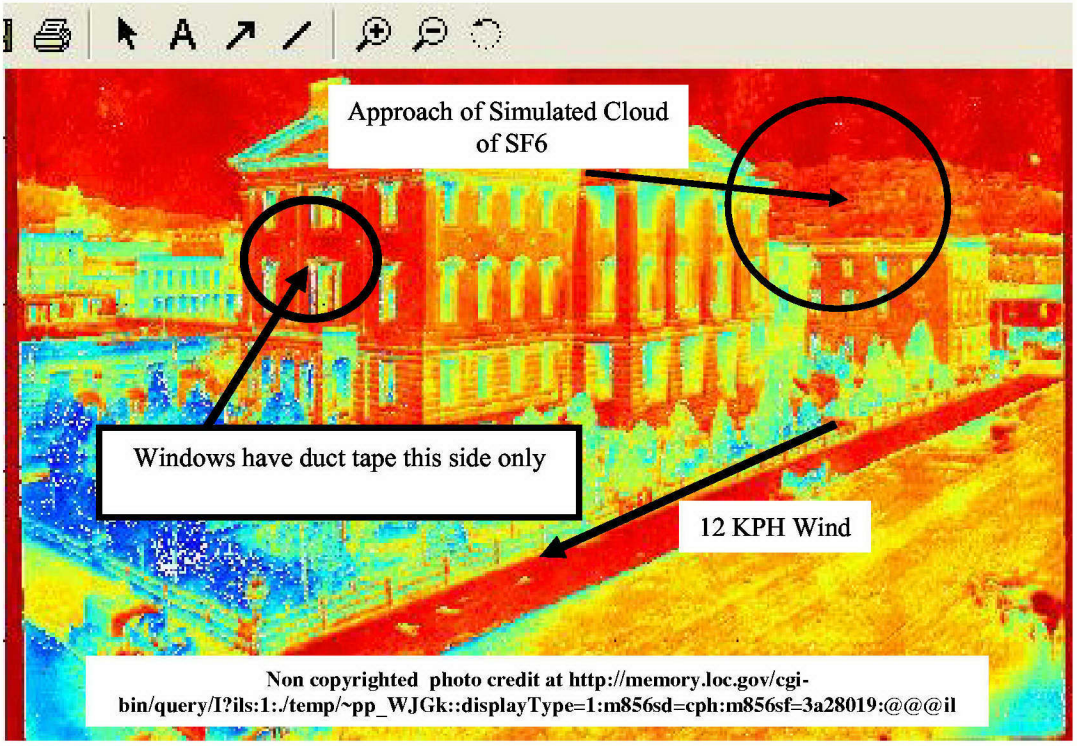
Emordnilap Image

As in STOP=POTS when flipped. Gives House (Y) or Watermark (Z)

Y & Z



IR Image Number one:**Cover Image**
Original Photograph: non copyrighted Located at http://memory.loc.gov/cgi-bin/ query/ r?pp/ils: @filreq(@field(NUMBER+@band(cph+3a28019))+@field(COLLID+lawhou))



IR Image Number two : **Annotation Watermark**
Watermark showing some of the conditions that occurred during a simulated cloud release of SF6 in low wind conditions. Also note the photograph credit at the bottom of the photograph